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ABSTRACT

To investigate the applicability of schema-theoretic notions to young children's comprehension of textually explicit and inferrable information, slightly above-average second grade readers with strong and weak schemata for knowledge about spiders read a passage about spiders and answered wh-questions tapping both explicitly stated information and knowledge that necessarily had to be inferred from the text. Main effects were found for strength of prior knowledge, and question type. Simple effects tests indicated a significant prior-knowledge effect on the inferrable knowledge but not on explicitly stated information. A follow-up study was conducted to verify the fact that the question-type effect was not due to the chance allocation of inherently easier questions to one of the two question types. The findings revealed a reliable decrease in question difficulty attributable to cuing propositional relations explicitly in the text. The data were interpreted as supporting and extending the arguments emerging from various "schema theories." (Author)

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CENTER FOR THE STUDY OF READING

Technical Report No. 116

THE EFFECT OF BACKGROUND KNOWLEDGE ON YOUNG CHILDREN'S COMPREHENSION OF EXPLICIT AND IMPLICIT INFORMATION

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Abstract

To investigate the applicability of schema-theoretic notions to young children's comprehension of textually explicit and inferrable information, slightly above-average second grade readers with strong and weak schemata for knowledge about spiders read a passage about spiders and answered wh-questions tapping both explicitly stated information and knowledge that necessarily had to be inferred from the text. Main effects were found for strength of prior knowledge ($p < .01$), and question type ($p < .01$). Simple effects tests indicated a significant prior knowledge effect on the inferrable knowledge ($p < .025$) but not on explicitly stated information. A follow-up study was conducted to verify the fact that the question type effect was not due to the chance allocation of inherently easier questions to one of the two question types. We found a reliable decrease in question difficulty attributable to cuing propositional relations explicitly in the text ($p < .01$). These data were interpreted as supporting and extending the arguments emerging from various "schema theories."

The Effect of Background Knowledge on Young Children's Comprehension of Explicit and Implicit Information

Few theoreticians, researchers, teachers, or laymen would argue with the assertion that readers' background knowledge influences the degree to which they can comprehend text. In fact, the conventional wisdom in teaching reading makes just such an assumption when it emphasizes teaching vocabulary, building background for a selection, or even setting purposes for reading a particular text. Presumably each of these activities serves either to build or to make apparent exactly those knowledge structures that will facilitate readers' comprehension of ideas presented in a text.

Ausubel's (1963, 1968) notion of advance organizers and the role that they serve in providing the ideational scaffolding for new ideas presented in a text seems to be based upon notions similar to those underlying the conventional wisdom in providing students with pre-reading activities.

Until recently, conceptualizations regarding the relationship between prior knowledge structures and text comprehension have been fairly vague. However, recent views of comprehension have tried to specify the role that prior knowledge plays in anchoring "new" textual information . In particular, the schema-theoretic notions of Rumelhart and Ortony (1977), Anderson, Spiro, and Anderson (1978), and Rumelhart (in press) have provided a more explicit account of how new specific textually-presented ideas become anchored in more abstract schemata (pre-existing knowledge structures) during reading.

While it goes beyond the scope of this article to specify the particular components and operations in a schema-theoretic view of comprehension, (see Rumelhart, in press) certain predictions from schema theory are relevant. If reading comprehension involves binding specific textual information to abstract schemata, then readers who have a better developed schema for a particular topic should understand and remember more than those with a weaker schema. If a text, because of its ambiguity, invites more than one schematic instantiation, then recall of specific details ought to be a function of how well those details match the particular schema instantiated.

A variety of such predictions from schema theory have received empirical verification. For example, Anderson, Reynolds, Schallert, and Goetz (1977) found that recall and comprehension of passages which invited two schematic interpretations (wrestling versus a prison break or card-playing versus a music rehearsal) was highly related to the background knowledge of the readers and/or environment in which the testing occurred. Physical education students in a physical education class setting chose the wrestling interpretation of the first passage but the card playing interpretation of the second; music students in a music class chose the alternative interpretation of each passage. Bransford and McCarrell (1974), using similarly ambiguous passages, found that subjects tended to recall propositions that were consistent with the particular theme (Peace march or Spaceship landing) they were given.

Bransford and Johnson (1973), using obscure passages with college students, found that recall was greatly facilitated when subjects were provided with scheme-evoking contexts in the form of a topic (main idea) for the passage or a clarifying picture.

A number of studies (e.g., Meyer & McConkie, 1973; Mandler & Johnson, 1977; Brown & Smiley, (in press) have demonstrated that subjects recall information judged to be important to a particular theme or scheme better than information judged to be less important. Furthermore, Anderson, Spiro, and Anderson (1978), by embedding the same specific target information in two different schematic contexts, demonstrated that the "ideational scaffolding" attributes of the context, rather than the differential learnability or memorability of the target information, was responsible for the superior recall of target information in the one context versus the other.

The present study, while continuing in the same tradition as those previously cited, differs in several specific features. First, unambiguous text (a second grade selection about spiders) was used. Second, young subjects (average ability second grade students) served as the population of readers. Third, comprehension was assessed by asking wh-question probes rather than eliciting free recall. Fourth, prior knowledge was manipulated by assessing how much each subject knew about the topic to be read rather than by implanting some schematic information in the text or the reader's mind prior to reading.

Unambiguous text was used for reasons of ecological validity; we reasoned that while ambiguous text can be used to establish the power of

a variable, validation of that variable in natural text environments is necessary prior to wide-scale acceptance of a conclusion by the educational community. Younger subjects allowed us to investigate the applicability of these schema-theoretic operations to another population. Wh-comprehension probes served a twofold function: (1) to examine the schema-theoretic hypotheses with different dependent measures, particularly those commonly used in school settings; and (2) to look at the differential effects of prior knowledge on probes that required integration of prior knowledge and textual information versus those that could be answered solely on the basis of textually presented information. The strength of previously available schemata was assessed by asking students direct questions about the topic because we felt that such a technique might ultimately be useful to classroom teacners as a diagnostic tool, should we also be able to demonstrate that prior knowledge affected comprehension.

The predictions from schema theory for the present experiment are straightforward: (1) because of the superior ideational scaffolding provided by better developed schemata, students with high prior knowledge scores, in comparison to students with low prior knowledge scores, should exhibit superior comprehension of ideas explicitly stated in the text; however, (2) their comprehension of ideas requiring integration of prior knowledge and textual information should be even more dramatically superior to that of low prior knowledge students because of the obviously greater demand placed on students' pre-existing schemata in such a task.

Experiment 1

Method

Subjects. The subjects were second grade students who were reading approximately at or within one year above grade level. All had attained grade equivalent scores within a range of 2.5 - 3.7 on the Metropolitan Achievement Test, Form A, in September.

The students were selected from four classrooms, two classrooms in each of the two schools in a middle class suburb of St. Paul, Minnesota. Twenty-five students were given a test on knowledge of spiders. Then the 10 with the highest and the 10 with the lowest scores were selected to participate in the experiment. The 10 lowest (the weak schema group) received scores of 2 or 3 on the 8 pretest questions. The 10 highest (the strong schema group) received scores of either 5, 6, or 7. The mean number of correct responses given by the group with the weak schemata was 2.7 (SD = .81); the mean number correct for the strong schema group was 5.8 (SD = .63). This difference was significant (t = 9.09, df = 18, $p < .001$). The difference between the two groups on the reading subtest of the Metropolitan Achievement Test was not significant. The mean for the weak schema group was 3.13 and for the strong schema group 3.32 (t = .909, df = 18, $p > .05$). The difference between the two groups on I.Q. was also not significant. The mean I.Q. for the weak schema group was 114.80 and for the strong schema group 120.40 (t = 1.36, df = 18, $p > .05$).

It was therefore confirmed that the two groups, though different in amount of background information on spiders, were similar in reading ability and measured I.Q.

Materials. A list of eight pretest questions was prepared to assess the student's background knowledge of spiders. A basal reader selection on spiders (Fay, Ross, & LaPray, 1972) was rewritten to include additional information on spiders and a narrative line. The readability level of the revised selection was computed to be 2.8 by applying the Spache Readability Formula. The selection was typed on a primary typewriter. A list of twelve posttest questions was prepared using criteria from Pearson and Johnson (1978). Six of the questions fell into a category that Pearson and Johnson labelled textually explicit. Such questions are derived by performing a wh-transformation on some immediate constituent of a sentence in the text, as in (2) or (3). They are identical to Bormuth's (1969) category of rote questions. Six questions fell into Pearson and Johnson's scriptally implicit category. Such questions, while derived from and related to the text, necessarily require the reader to refer to prior knowledge to generate an answer, as in (4).

(1) The King prohibited public meetings because he was afraid of an uprising.

(2) Who prohibited public meetings?

(3) Why did the King prohibit public meetings?

(4) Why was the King afraid of an uprising?

Procedure

The pretests were administered over a one-week period in April. The students were pretested individually in a quiet hallway. Prior to administering the pretest questions the following directions were given to the students:

> I have eight questions to ask you. I'll ask you each question and you tell me the answer so I can write it down. Some of the questions are hard so just tell me what you think is correct. Some of them you may not know, so then tell me you don't know. The first question is:

The questions were then administered orally. One follow-up query was allowed per answer if the appropriateness of the initial answer was not clear. All of the oral responses were recorded verbatim and scored later. Responses were classified independently by each experimenter. There were no disagreements.

After a one week interval, the students read the actual selection. A small vacant room in each school was used to test the students individually. The following directions were given:

> Read this story to yourself. Read it just once. Read it carefully and don't hurry. If you meet some words you don't know, pronounce them to yourself as best you can and then go on. When you have finished reading, return the story to me. Then I'll ask you some questions about the story.

The twelve posttest questions were presented orally in an order that followed the story sequence; the six implicit and six explicit questions

were interspersed. Again, all responses were recorded and scored independently by each experimenter; there were no disagreements.

Results

The posttest results for the two prior knowledge groups and for both question types are reported in Table 1.

Insert Table 1 about here.

The strong schema group (M = 7.50) performed significantly better than the weak schema group (M = 4.80) overall, $F(1,18) = 8.40$, $p < .01$. Post hoc Scheffé contrasts indicated a significant difference between the groups on implicit questions, $F(1,18) = 7.46$, $p < .025$, but not on explicit questions, $F(1,18) = 1.87$, $p > .10$).

There was a significant within-subjects main effect for question type, $F(1,18) = 30.32$, $p < .01$ indicating that explicit questions (M = 4.25) were easier than implicit questions (M = 1.90). The prior knowledge by questions type interaction was not significant, $F(1,18) = 1.13$, $p > .05$.

Discussion

The findings in the present study support the intuitively sensible contention that the background experiences readers bring to a selection affect the depth to which they can understand it. The main effect for prior knowledge and the lack of a prior knowledge by question type interaction suggest that the effect is comparable for both explicit and implicit questions. However, post hoc Scheffé tests indicated that the

effect of prior knowledge is more pronounced for implicit (requiring an integration of textual information and prior knowledge) than for explicit questions.

In terms of schema theory, the findings support the notion of comprehension as a process of integrating novel information into pre-existing schemata. First, if the schemata are weakly developed, comprehension requiring integration of new and known information (implicit questions) is difficult. Second, comprehension of potentially novel information (explicit) is slightly, but not significantly, facilitated when schemata are strong. These findings are largely but not wholly consistent with the predictions made earlier. Significant simple effects for prior knowledge on both question types, coupled with a significant prior knowledge by question-type interaction would have provided stronger support for those predictions. Yet the results are in the right direction and the prior knowledge effect for implicit questions appears quite reliable.

The study has several limitations. First, it would be useful to replicate the effects with a real "population" of paragraphs. Second, the question type effect is somewhat suspect. That is, it may be that the greater difficulty of implicit questions may have been an artifact of the particular set used in this study. If this were the case, then both the question type effect and the simple effect of prior knowledge on implicit questions could be questioned. To investigate this possibility a second study was carried out.

Experiment 2

Method

Subjects. Twenty second-grade students from a middle class suburban school who were reading at or within one year above grade level in the Metropolitan Achievement Test participated in the study.

Materials. The same passage used in Experiment I was rewritten in two forms. Ten questions were developed such that the five that were textually explicit in Form I would be scriptally implicit in Form 2 and vice-versa for the scriptally implicit in Form I. This was accomplished by differentially adding and deleting information between forms I and 2. For example, passage (5) might have been rewritten as (6) so that questions (7) and (8) would change categories from one form to the next. In other words the questions remained constant from one form to another; however the information available in the passage was varied between forms.

(5) John baked Mary a cake because it was her birthday. John could tell she was surprised when she saw it.

(6) John baked Mary a cake. John could tell she was surprised when she saw it by the way she jumped up and down and clapped her hands.

(7) Why did John bake Mary a cake?

(8) How could John tell she was surprised when she saw it?

Procedures. With the omission of a prior knowledge test, the data were collected and scored exactly as in Experiment I.

Results. Posttest results (Table 2) indicated a significant main effect for question type, $F(1,18) = 17.64$, $p < .001$, but not for form, $F(1,18) = .34$, $p > .05$. Hence the overall question type effect was replicated. The most interesting effect was the significant form by

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Insert Table 2 about here.

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question type interaction, $F(1,18) = 11.56$, $p < .01$. The interaction results from the addition of a constant amount of difficulty for question type (a mean of about 1.00) to two sets of questions which differ inherently in average difficulty (2.8 versus 3.65).[1]

Discussion. These results suggest that while the question sets used in the study differed from one another in their basic difficulty, there was a relatively constant amount of difficulty attributable to removing textually explicit information useful in answering the question. Hence the possible limitation noted in the discussion of Experiment I seems unwarranted. Comprehension of textually explicit information is easier than comprehension requiring integration of textual information and prior knowledge. And the previous conclusion that comprehension requiring such integration is especially facilitated by strong schemata remains plausible.

General Discussion

In general these results confirm and extend the conclusions drawn by those who have previously demonstrated the effect of schemata on the comprehension of text. Students with well developed schemata on a topic

are able to answer more questions about a passage than those with weakly developed schemata. This effect is particularly prominent when the questions require prior knowledge to be accessed. By way of extension, schema-theoretic operations have been shown to operate (1) with younger populations, (2) in typical environments with typical texts, and (3) across different dependent measures.

These results suggest two possible implications for teaching. First, to ensure more thorough comprehension, teachers might spend more time developing background knowledge prior to reading. In this regard we should mention the salutary effects of intensive semantic network pre-teaching found by Schachter (1978) and Swaby (1977) for specific populations with specific types of text, as well as a study by Sloan and Pearson (1978), which suggests that almost any type of teacher intervention helps poor readers' comprehension of difficult technical material. However, we need more instructional research in order to specify the populations of students and texts for which such intervention aids comprehension. In other words, we need to take the advice of Bransford, Nitsch, and Franks (1977) more seriously and face squarely the issue of how "changing states of schemata" influences subsequent comprehension.

Second, probes requiring the integration of schematic and textual information, since they seem to be inherently more difficult, may require specific teacher guidance. Even with relatively adequate development (strong schema group), readers in this study found scriptally implicit questions more difficult than textually explicit questions. Apparently that extra step of integration invites variability if not inaccuracy in response.

The suggestion of teacher guidance on each of these issues, specific content and inferential processing, seems reasonable and plausible. However both these suggestions represent empirically resolvable issues and deserve to be answered through experimentation rather than speculation.

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Footnotes

[1]These means result from averaging the diagonally adjacent cell means in Table 2.

Table 1

Mean Number of Correct Responses on Posttest

(Experiment 1)

Prior Knowledge	Question Types		
	Explicit	Implicit	Total Posttest
Groups			
Strong Schema	4.70 (1.16)[a]	2.80 (1.62)	7.50 (1.80)
Weak Schema	3.80 (1.69)	1.00 (1.05)	4.80 (2.30)
Average for groups	4.25 (1.48)	1.90 (1.02	

[a]Numbers in parentheses are standard deviations.

Table 2

Mean Number of Correct Responses on Posttest

(Experiment 2)

	Question Types		
	Explicit	Implicit	Total Posttest
Form I	3.3 (.68)[a]	3.1 (.88)	6.4 (1.26)
Form II	4.2 (.92)	2.3 (.81)	6.5 (1.18)
Average across forms	3.75 (.91)	2.7 (.72)	

[a]Numbers in parentheses are standard deviations.

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